TECHNICAL COMMITTEE REPORT:

YUKON RIVER SALMON RUN OUTLOOKS FOR 2001

Prepared by

THE CANADA/UNITED STATES
YUKON RIVER JOINT TECHNICAL COMMITTEE

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1.0 INTRODUCTION

The U.S./Canada Yukon River Joint Technical Committee (JTC) was tasked by the Chief Negotiators, to prepare salmon outlooks for the 2001 season prior to a negotiation session scheduled for late March 2001. It was agreed that the required report would be prepared jointly, but without calling a meeting of the JTC. This written report is a result of that collaborative effort.

In addition, the Yukon Panel convened a meeting in Whitehorse Yukon on March 30, 2001 after a negotiation session that resulted in an agreement which is pending ratification. After careful consideration the Panel came up with the following wording for the 2001 escapement goal of for chinook salmon into Canada:

> *"The Panel, recognising the present regime of low returns and recognising the difficulties faced by people on both sides of the border, recommends to the two management entities that they plan to fish to a maximum of 50% of the normal subsistence catch on the Alaskan side of the border and 50% of the normal aboriginal catch on the Canadian side of the border. It is recommended that Commercial fisheries remain closed on both sides of the border unless in-season estimates indicate that sufficient fish are returning to justify them. The expectation of this regime is that no fewer than 18,000 fish will reach the spawning grounds."*

The management agencies intend to implement plans based on the recommendation from the Yukon River Panel.

2.0 2001 YUKON RIVER SALMON RUN OUTLOOKS

2.1 *ALASKA*

2.1.1 Chinook Salmon

Yukon River chinook salmon return primarily as age-5 and age-6 fish, although age-3, age-4, age-7 and age-8 fish also contribute to the run. Spawning ground escapements in 1995, the brood year producing 6-year-old fish returning in 2001, were judged to be above average in magnitude. However, the chinook salmon runs in 1998, 1999 and 2000 appeared to be well below average in strength indicating abnormally poor production from parent year escapements. Additionally, the apparent low marine survival from age-5 fish returning in 1999, and sibling age-6 fish returning in 2000, continued to show recent below-average trends in survival. Based on continued recent below-average trends in survival rates of parent year escapements, and the number of 4- and 5-year-old fish that returned in 2000, the return of 5- and 6-year-old fish in 2001 is expected to be poor.

Overall, the year 2001 chinook salmon run is anticipated to be below average to poor in strength for the fourth year in a row. Given the uncertainties associated with recent declines in productivity, it is unlikely the run will support a commercial harvest and will potentially require reductions in subsistence harvest opportunity. The fisheries are

managed based upon inseason assessments of the actual runs. If inseason qualitative indicators of run strength suggest sufficient abundance exists to have a commercial fishery, the commercial harvest in Alaska would be 0 to 20,000 chinook salmon (0 to 18,000 fish in the Lower Yukon Area and 0 to 2,000 fish in the Upper Yukon Area). This represents a range of catch well below all other years with the exception of 2000 during the previous 30-year period.

The Alaska Board of Fisheries recently modified the Yukon River King Salmon Management plan by adding a fishing schedule for the subsistence salmon fisheries. In the past, subsistence fishing prior to opening the commercial fishing season, had been allowed 24 hours a day, 7 days per week within most areas of the Alaska portion of the Yukon River drainage. The subsistence fishing schedule, enacted by the Alaska Board of Fisheries, identified the amount of fishing time a district, subdistrict or area needed to obtain an average subsistence harvest during a normal chinook salmon run. Accordingly, the new schedule limits the amount of subsistence fishing time allowed during each week in each district, subdistrict or area. This subsistence fishing schedule was specifically designed to aid in distributing the subsistence harvest over the entire run and also allow a portion of the chinook salmon run to move through some districts unmolested.

2.1.2 Summer Chum Salmon

Based on above average escapements in 1996 and 1997, an above average return of 4- and 5-year-old summer chum salmon would normally be expected in 2001. However, it appears that, similar to many chinook and chum salmon stocks in Western Alaska, Yukon River summer chum salmon stocks are also experiencing drastic reductions in productivity. For example, production of the Anvik River chum salmon stock, the largest summer chum salmon spawning stock within the Yukon River drainage, has fallen well below 1 return per spawner in recent brood year returns. Additionally, nearly all other Yukon River chum salmon stocks are continuing to exhibit similar decreased production levels, in some cases bordering on production failure. There is uncertainty as to how long this situation might continue, and whether productivity could drop even further. While exact reasons for the run failures are unknown, the general decrease in salmon run sizes has not been attributed to poor parent year escapements. Most parent-year escapements that produced these very poor runs were considered adequate, if not good. It is widely speculated, however, that poor marine survival, related to localized weather and ocean conditions in the Bering Sea, are the primary factors currently affecting salmon production.

Overall, the 2001 outlook is for a below average to poor summer chum salmon run. Given the recent observed declines in salmon productivity, it is unlikely that the 2001 run will support a commercial harvest. A poor run and could require reductions in subsistence harvest opportunity to provide for escapements. If inseason qualitative indicators of run strength suggest sufficient abundance exists to consider allowing a commercial fishery, the commercial harvest in Alaska would be between 0 to 300,000 summer chum salmon.

2.1.3 Fall Chum Salmon

Yukon River fall chum salmon escapements for the period 1974 through 1993 were estimated and have ranged from approximately 110,000 (1982) to 1,200,000 (1975) by ADF&G, based upon expansion of escapement assessments drainage-wide. These escapements have produced returns that ranged in size from approximately 301,000 (1988 production) to 1,400,000 (1975 production) fish. Corresponding return per spawner rates have ranged from 1.1 to 4.5 with an average of 2.5 for all years combined through 1993. Recent year runs have decreased significantly with production falling below one return per spawner.

Yukon River fall chum salmon return primarily as age-4 or age-5 fish, although age-3 and age-6 fish also contribute to the run. The parent year escapements of 1996 and 1997 will be producing the majority of the fish returning in 2001. Drainage-wide escapements in 1996 were well above average while escapements 1997 were slightly above average with weaknesses in the Tanana River drainage. Due to staff vacancies and time constraints, a projection of returning fall chum salmon to the Yukon River is not yet complete. Similar to summer chum salmon, production has fallen well below 1 return per spawner in recent brood year returns and in some cases, are bordering on production failure. There is uncertainty as to how long this situation might continue, and whether productivity could drop even further. While exact reasons for the run failures are unknown, it is widely speculated that poor marine survival related to localized weather and ocean conditions in the Bering Sea are primary factors. Weakness in the salmon runs has been attributed to reduced productivity and not the result of low levels of parent year escapements.

Even though parent year escapements appeared adequate, the 2001 fall chum salmon run is anticipated to be poor to below average in strength for the fifth consecutive year. Given recent trends in low productivity, it is very probable the 2001 fall chum salmon run will be less than 500,000 fish. There will likely be no directed commercial fishery and subsistence restrictions may be necessary in attempt to meet the optimal escapement goal.

2.1.4 Coho Salmon

Although comprehensive escapement information on Yukon River drainage coho salmon is lacking, it is known that coho salmon primarily return as age-4 fish and overlap in run timing with fall chum salmon. An average return of coho salmon would be anticipated in 2001, based upon parental escapement levels observed in several spawning streams in 1997 and assuming average survival. However, should mortality factors that contributed to recent Western Alaska salmon run failures in recent years also affect marine survival of coho salmon from the 1997 brood year, then a below average run of coho salmon could be expected in 2001.

The Alaska Board of Fisheries recently readopted the Yukon River coho salmon management plan that would allow a directed commercial coho salmon fishery, but only under very unique conditions. Directed coho salmon fishing is dependent on the assessed levels of both coho and fall chum salmon since they commonly return mixed together. A

directed commercial coho salmon fishery is not likely to occur in 2001 because of the poor outlook for the fall chum salmon combined with an average coho salmon return.

2.2 *CANADA*

2.2.1 Upper Yukon Chinook Salmon

The expected total run size of Canadian origin upper Yukon[1] River chinook salmon for 2001 is approximately 37,000 fish. This forecast is based on an initial stock- recruitment projection of 124,400 chinook salmon that was reduced by the proportion that the YR 2000 run fell below the forecast made for that year. This approach was used to account for the declining trend in Yukon chinook salmon returns. Available information suggests that this trend is the result of poor marine survival. By comparison, the upper Yukon chinook run size averaged approximately 107,000 fish during the recent six-year cycle from 1995 to 2000[2]. The 2001 run is therefore expected to be poor in magnitude.

The 2001 run outlook is based on escapement data for 1993 through 1998, and calculated returns per spawner for the individual brood year escapements based on the spawner-recruitment relationship for the 1980 to 1995 brood years; the outlook has been adjusted downwards to reflect the poor survival of Yukon chinook salmon evident over the past few years. The potential for reduced marine survival has been made apparent by the 1998, 1999 and 2000 runs of upper Yukon chinook salmon which were significantly below expectations; the estimated run sizes for these years were 70,000, 90,000 and 38,000, respectively. These poor run sizes occurred despite excellent brood year spawning escapements.

The interim escapement goal range for rebuilt upper Yukon chinook (excluding the Porcupine) is 33,000 to 43,000 chinook salmon. In recognition that chinook escapements were depressed, the Yukon River Panel developed a rebuilding goal of >28,000 for the period 1996 through 2001 which both Parties have been endeavouring to manage towards. All three of the principal brood years for the 2001 run exceeded this target, although all were below the lower end of the target range for rebuilt stocks.

The run outlook for 2001 was developed using the relationship between spawning escapement and production for the 1980 to 1995 brood years and factoring in the potential for reduced marine survival. Production estimates incorporated age composition data from escapements, and from harvests of Canadian origin chinook salmon in the U.S. and Canada. Annual returns were reconstructed using ADF&G scale pattern data and Fisheries and Oceans Canada tagging results. When age composition data were not available for individual years, averages were substituted, or, in the case of spawning escapements, adjusted age data from the Fisheries and Oceans Canada fishwheels

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[1] The upper Yukon River, for the purpose of Section 2.2 of this report, is defined as the Canadian portion of the Yukon River drainage excluding the Porcupine River drainage.

[2] The 2000 run size estimate is preliminary.

upstream of the Canada/U.S. border were used. Total escapements for 1980-81 and 1984 were estimated by expanding a cumulative five-area escapement index (Tatchun Cr., Big Salmon R., Nisutlin R., Wolf R., and the non-hatchery returns to the Whitehorse Fishway) by the average proportion the index represented of the total escapement estimates. Mark-recapture results were used to estimate the escapement in 1982, 1983 and 1985 through 2000.

The relationship between the natural logarithm of the return per spawner (R/S) and number of spawners (S) for the 1980 to 1995 brood years is described as follows:

$$\text{Equation [1]: } \mathbf{Ln\ (R/S)=2.395-0.000033(S)};$$

where: S = # spawners (in thousands), R = returns.

The coefficient of determination (r^2) of this regression is 0.45 and the relationship is significant ($p<0.05$).

The 2001 return was estimated by first, calculating the total expected return from each brood year escapement based on equation [1] and then, apportioning it by the average age composition of brood year returns. For example, the escapement of 32,262 chinook in 1995 is expected, under normal survival conditions, to produce 124,732 chinook, all ages combined. However, only age-6 chinook will be returning in 2001 from the 1995 brood year. To calculate the number of age-6 chinook expected from the 1995 brood year, the expected total production of 124,732 was apportioned by the average age composition of brood year returns. Over the 1980-1995 period, the average age composition of brood year returns is as follows: <0.05% age-3, 4.4% age-4, 24.3% age-5, 59.1% age-6, 11.8% age-7, and 0.3% age-8. Therefore, it is expected that 59.1% of the production from 1995 will return as age-6 chinook in 2001; this equals 73,696 fish. The calculations for this and the other brood years are summarised in the table below:

Brood Year	Escapement	Calc'd Ln(R/S)	Calc'd R/S	Est'd prod'n	2001 Return
1993	28,558	1.483	4.404	125,782	413
1994	24,441	1.613	5.018	122,636	14,475
1995	32,262	1.352	3.866	124,732	73,696
1996	28,409	1.483	4.404	125,126	30,476
1997	37,683	1.157	3.180	119,818	5259
1998	16,750	1.841	6.303	105,576	41
Total (unadjusted for poor marine survival)					124,361
2001 expected run size (adjusted for poor survival)					37,000

The point estimate of 124,400 chinook salmon does not incorporate the wide 95% confidence interval range for the Yukon chinook stock recruitment relationship or the

recent trend towards decreased marine survival. It is therefore considered to be optimistic. Stock recruitment relationships are usually developed from density dependent relationships developed for a single stock rather than the aggregate of a number of stocks as is used for Yukon River outlooks. A similar approach based on traditional production models resulted in a run outlook of 136,000 for 1999. However, the preliminary estimate of the 1999 upper Yukon chinook run size was approximately 90,000 fish, 66% of the expected run size. Similarly, a run outlook of 128,000 developed for YR 2000 was not realized. The preliminary post-season estimate of the YR 2000 upper Yukon chinook run size was approximately 38,100 fish, only 29.7% of the expected run size. If the 2001 outlook over-estimates the actual run size in the same manner, it would be more realistic to expect a run size of 37,000. This is reflected in the table above and is used to give a more realistic outlook for 2001.

Chinook run outlooks based on stock-recruitment data have been included in the Canadian Yukon management plans since 1991. To examine how well this method has performed, annual run outlooks based on stock-recruitment data as described in respective plans since 1991, were compared to actual estimated run sizes. Over the period 1991 to 1999, the mean absolute percent error was 25%. In other words, for this period of time, the annual forecasts were off by an average of 25% (range = 3% to 112%). Run forecasts over-estimated the actual run sizes in four years, and underestimated them in five years. Not surprisingly, the years with the greatest discrepancies included 1998 and 1999 when the forecast overestimated the runs. This pattern was also consistent for the 2000 return. As inferred previously, a significant reduction in marine survival could explain the poor performance of the forecasts in these three years. If the 1998 and 1999 forecasts are ignored, the mean absolute percent error is reduced to about 10%.

2.2.2 Upper Yukon Chum Salmon

An average of 65% of upper Yukon adult chum salmon return at four years of age and 33% return at five years of age. This suggests that the major portion of the 2001 fall chum run should originate from escapements of 122,429 in 1996 and 85,439 in 1997.

The primary brood year escapements are among the highest escapements recorded within the 1982-2000 period and are well above the recent (i.e. 1997-2000) cycle average of approximately 63,000 fish and the minimum escapement goal for rebuilt upper Yukon chum salmon of >80,000 fish.

A return rate of 2.5 adults per spawner (R/S) was used in the joint Canada/U.S. upper Yukon chum salmon rebuilding model and has been used in most years by Fisheries and Oceans Canada for developing pre-season run expectations[3]. It matches the long-term (i.e. 1974-1992) R/S relationship for the estimated drainage-wide Yukon River fall chum salmon stock aggregate. The 2001 expectation using this rate is a run size of 245,000 fall

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[3] The adult per spawner return (R/S) for the 1982 to 1995 brood years was 2.5 while the return for the most recent cycle year period (1992-95) was 2.0. The estimated R/S for brood years 1994 and 1995 were only 0.8 and 0.7, respectively, and this has been attributed to low marine survival.

chum salmon which falls below the upper end of the expected range for both 1999 and 2000 of 336,000 and 334,000, respectively. However, the 1999 estimated upper Yukon River fall chum run size of 106,600 was only 32% of the upper range of the anticipated run size, likely as a result of poor marine conditions. Similarly, the estimated upper Yukon River fall chum return in 2000 of 76,300 was only 23% of the upper range of the anticipated run size of 334,000. It is reasonable to assume that poor marine conditions will again affect the 2001 run resulting in a similar run shortfall . The 2001 run size expectation is therefore expressed as a range from 67,400 to 245,000 chum salmon; it is expected the actual run size will be close to the lower end of the range

Brood Year	Escapement	Est'd prod'n @ 2.5 (R/S)	% contribution based on age	2001 Return
1995	158,029	395,072	0.013	5,136
1996	122,429	306,072	0.328	100,392
1997	85,439	213,597	0.648	138,411
1998	46,255	115,637	0.011	1,272
Total run				245,211
2001 expected run size range (unadjusted for poor survival)				245,000
2001 expected run size range reduced by 72.4% and rounded				67,400

Although insufficient stock identification data are available for accurately estimating annual run sizes of upper Yukon chum salmon, assumptions have been made to allow the 2001 outlook to be expressed in terms of recent run sizes. Run size estimates for previous years were developed based on the following Fisheries and Oceans Canada assumptions:

1/ 30% of the total U.S. catch of fall chum salmon is composed of Canadian origin fish;
2/ the U.S. catches of Canadian-origin upper Yukon and Porcupine fall chum are proportional to the ratio of their respective border escapements; and,
3/ the Porcupine border escapement consists of the Old Crow aboriginal fishery catch plus the Fishing Branch River escapement.

Using these assumptions, the recent four-year cycle (1997-2000) return of upper Yukon Canadian-origin chum salmon is estimated to have been approximately 93,000 fish. In comparison, the 2001 upper Yukon chum salmon expectation of 67,000 to 245,000 fish ranges from poor to above average. Since recent runs have decreased with production falling below one return per spawner, the lower range of the outlook (67,000) has been adopted and the 2001 run is expected to be poor.

The chum salmon run to Canadian portions of the Porcupine drainage in 2001 should originate primarily from the 1996 and 1997 escapement. The escapement to the Fishing Branch River, as determined by a weir count, was 77,278 chum salmon in 1996 and 26,959 in 1997. These counts were well above the 1997-2000 cycle average of 14,417

fish. The trend for this period had been towards decreasing escapements; counts for 1997, 1998, 1999 and 2000 were 26,959, 13,564, 12,094 and 5,053, respectively. The escapement observed in 1996 exceeded the lower end of the interim escapement goal range of 50,000 to 120,000 chum salmon while the escapements observed in the 1997-2000 period were well below the lower end of the goal.

The productivity of the Fishing Branch River chum stocks appears to be lower than that of both the drainage-wide stock aggregate and the upper Yukon stock aggregate, particularly when averaged over the 1988 to 1991 brood years. The returns from the 1992 to 1995 brood years have not yet been estimated. Rather than using a R/S value of 2.5, Fisheries and Oceans Canada has prepared a stock-recruitment brood table using the assumptions listed above. The average productivity of brood years 1982 through 1991 was estimated to be a R/S rate of 2.2, and this was used to develop the 2001 forecast.

Assuming a R/S value of 2.2, and using the average age at maturity for Fishing Branch chum salmon of 60% age-four and 36% age-five, a return of 101,000 fish is expected in 2001.

Brood Year	Escapement	Est'd prod'n @ 2.2 (R/S)	%contribution based on age	2001 Return
1996	77,278	170,012	0.36	61,204
1997	26,959	59,310	0.60	35,586
Sub-total				96,790
Total (adjusted for other age classes)				100,823
2001 expected run size range (unadjusted for poor survival)				101,000
2001 expected run size reduced by 85.5% and rounded				14,600

The total Canadian-origin Porcupine chum run size, i.e. Fishing Branch stock was estimated to have been approximately 31,000 fish over the 1997-2000 four-year cycle (based on the assumptions previously stated). The average for the 1993-2000 period was 61,000 fish. As with the upper Yukon River chum expectation, it was felt that the expected run size should be initially expressed as a range, in light of the run shortfalls experienced in 1999 and 2000. In 1999, the estimated run size of 23,300 chum salmon was only 19% of the expected run size of 124,000 fish. Similarly, in 2000, the estimated run size of 14,800 was only 10% of the expected run size of 150,000. The outlook of 101,000 fish for 2001 was therefore reduced by 85.5%, the average of the two shortfalls, to obtain the lower end of the expectation range. Therefore, a run of between 14,600 and 101,000 Fishing Branch River chum salmon is expected for 2001 with the anticipation that the run will be towards the lower end of the range. This expectation has been expressed with some ambiguity due to the uncertainty associated with marine conditions. Since recent runs have significantly and consistently decreased, the outlook of 14,600 chum salmon adopted for the 2001 return is a projection of a poor return.